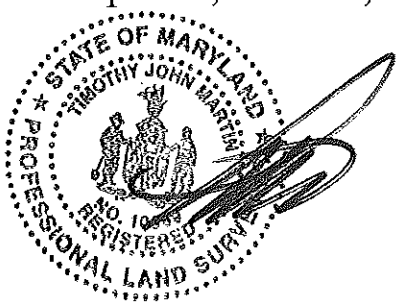
Bay Engineering, Inc.
Engineers, Planners and Surveyors

STORMWATER MANAGEMENT REPORT

FOR

CB Property Solutions, LLC
Lot 2

425 Third Street
Tax ID: 06-000-90249329
Tax Map 52D, Grid 10, Parcel 351



1-4-21

Provided by:
Bay Engineering, Inc.
2661 Riva Road, Building 800
Annapolis, MD 21401

Date: March, 2019
Revised: January, 2021

I. Narrative

A. Introduction

This report contains an analysis that outlines the stormwater management obligations for this site. We evaluated management obligations, using Environmental Site Design (ESD), for Water Quality (WQ_v), Recharge (Re_v), and Channel Protection (Cp_v). For each of the requirements, we offer an assessment regarding the need for management, as well as the type of practice if management is required.

B. General Site Information

The site is known as the 425 Third Street located on Tax Map 52D, Grid 10, Parcel 351, and contains 0.0995 acres ± (4,335 square feet). The parcel is located in the City of Annapolis on Third Street in Annapolis, Maryland. The site is currently zoned R2-NC. The site is not within the 100-year FEMA floodplain and is located within the Chesapeake Bay Critical Area – IDA (intensely developed areas). The site will also have public water and sewer needing to be installed on site.

Existing Conditions

As mentioned, the parcel consists of 0.0995 acres ± (4,335 square feet) and is currently in a partially developed state. The site currently contains an existing shed and concrete sidewalks. The site will continue to drain towards the western property lines. The site consists of one soil types which is AuB (C soil). The soil classification is based on USDA web soil survey records.

Developed Conditions

The proposed detached will consist of the development of a new house, permeable pavement driveway and garage. Stormwater management will also need to be constructed to manage post development conditions.

The site has been designed to provide the least amount of environmental impacts. The impervious coverage has been kept to the minimum practicable for a lot of this size and in keeping with the surrounding community. Non-structural ESD practices have also been provided in conjunction with the minimization of new impervious coverage.

C. Stormwater Management Design

The Stormwater Management concept for this project was designed to meet the requirements of the Stormwater Management Act of 2010.

This stormwater management plan was developed with all treatment options in mind; however, in this design the use of non-structural practices were needed to achieve the total ESDv volume required. One Micro-Bioretention (M-6) and Three Raised Rain Gardens (M-6) were utilized to

achieve the ESDv required for the site. The raised rain gardens are the maximum size that will fit on the property. They extend all around the house where they are practical. Every effort has been made to achieve the City recommendation of 125% treatment volume. This was not possible due to site constraints, so a variance is being sought to the 125% requirement.

Erosion and sediment control was integrated into the stormwater management strategy by using non-structural treatment techniques and limiting grading and disturbance which produce sediment and erosion.

D. Unified Stormwater Sizing Criteria

Methodology

In accordance with the 2010 Maryland Stormwater Design Manual, Volumes I & II, the site was designed implementing Environmental Site Design (ESD) to the maximum extent practicable (MEP). As a minimum, ESD shall be used to address both Recharge (Re_v) and Water Quality (WQ_v) requirements. Channel Protection (Cp_v) obligations are met when ESD practices are designed according to the Runoff Curve Number Method where developed conditions return the site to an RCN of "woods in good condition".

Water Quality Requirements (WQ_v)

The site has been analyzed for water quality obligations based on the proposed development. Water quality obligations (WQ_v) will be met on this site by the successful implementation of ESD practices, specifically, One Micro-Bioretention (M-6) and Three Raised Rain Garden (M-6).

Recharge Requirements (Re_v)

The site has been analyzed for recharge volume obligations based on the proposed development. Recharge volume obligations (Re_v) will be met on this site by the successful implementation of ESD practices, specifically One Micro-Bioretention (M-6) and Three Raised Rain Garden (M-6).

Channel Protection Requirements (Cp_v)

The site has been analyzed for Channel Protection Volume (Cp_v) obligations based on the proposed development. Cp_v obligations will be met on this site by the successful implementation of ESD practices, specifically, One Micro-Bioretention (M-6) and Three Raised Rain Garden (M-6)

Overbank Flood Protection Volume Requirements (Qp_{10})

Extreme flood control is not required for this site because there are no floodplain areas downstream of the site and there are no historical flooding problems downstream of the development.

Extreme Flood Volume Requirements (Q_f)

There is no evidence of existing downstream flooding or erosion and no downstream flooding or erosion should occur as a result of this development. This site also has tidal outfall into a public storm drain on Third Street.

E. Environmental Site Design (ESD)

Title 4, Subtitle 201.1(B) of the "Stormwater Management Act of 2010" defines ESD as using micro-scale practices, non-structural techniques, and better site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources.

ESD was implemented in this project to the maximum extent practicable (MEP) to mimic "woods in good condition." In addition, the proposed development minimizes disturbance to existing environmental features. The site was analyzed based on the proposed impervious coverage and each impervious feature was analyzed to meet the ESD Sizing Criteria. Computations can be found in Section II.

F. Outfall Statement

The site will continue to drain towards the western property lines. The conveyance is stable, and should not be affected by this development due to minimization of impervious coverage, and due to storm water management provided on site.

STORMWATER MANAGEMENT STRUCTURE SUMMARY TABLE

Project Name: 425 THIRD STREET				Project No.:		Subdiv. No.:			
Bay Eng. No.: 18-6671		Design By: RA		Date: 3/15/2019		Tax Map/Block/Parcel: 52D / 000 / 351			
Overall DA	Practice	Structure No.	Type	Location		Drainage Area Treated (acres)	Maximum Volume for 1-Yr 24-Hr. Storm (Cu. Ft.)	Water Quality Volume (Cu. Ft.)	Actual Device Volume (Cu. Ft.)	Pe Provided (in.)
A	Micro-Bioretention	MB-1	M-6			0.056	133.27	133.27	146.50	2.97
	Raised Rain Garden	RRG-1	M-7			0.013	123.55	102.47	102.47	2.01
	Raised Rain Garden	RRG-2	M-7			0.006	52.80	46.40	46.40	1.14
	Raised Rain Garden	RRG-3	M-7			0.018	51.94	51.94	121.80	1.35
	Non-Rooftop Disconnection	N-2	N-2			0.006	51.94	19.24	19.24	1.00
					Total	0.099	413.49	**353.31**	436.40	
					ESD_v Required			**325.19**		
					125% ESD_v Required			**406.49**		

Total Site P_e Provided:

SWM Provided for: New Development Conditions

P_e = 1.96 in.

Where:

ESD_v = 353.31 ft^3

R_v = 0.50

A (LOD Area) = 4,335 ft^2

**Note: These values taken from the Stormwater Management Requirements sheet of these computations.*

Stormwater Management Requirements

Project: 425 Third Street
Job No.: 18-6671
County: Anne Arundel
By: KMB *Date:* 02/26/19
Check: XXX *Date:* XX/XX/XX

Site Data

Existing Conditions

Site Area	0.10	ACRES	OR	4,335	SF
Limit of Disturbance	0.10	ACRES	OR	4,335	SF

Design Area used for ESD computations is Limit of Disturbance

Soils Types

HSG 'A'	0.00	ACRES	OR	0	SF	0.0% *of design area*
HSG 'B'	0.00	ACRES	OR	0	SF	0.0% *of design area*
HSG 'C'	0.10	ACRES	OR	4,335	SF	100.0% *of design area*
HSG 'D'	0.00	ACRES	OR	0	SF	0.0% *of design area*

Impervious Cover

Buildings	0.00	ACRES	OR	0	SF	
Paving	0.00	ACRES	OR	0	SF	
TOTAL	**0.00**	ACRES	OR	**0**	SF	0.0% *of design area*

Proposed Conditions

Impervious Cover

Buildings	0.05	ACRES	OR	2,168	SF	
Drives	0.00	ACRES	OR	0	SF	
Paving	0.00	ACRES	OR	0	SF	
Alternative Surfaces*	0.00			0	SF	
TOTAL	**0.05**	ACRES	OR	**2,168**	SF	100.0% *of design area*

* Alternative Surfaces include Permeable Pavers (A-2 ESD Device)

Determine Target ESD_V (Total Site)

Target RCN for "Woods in Good Condition"

HSG	Area (SF)	% Site	RCN
A	0	0%	38
B	0	0%	55
C	4,335	100%	70
D	0	0%	77

RCN_{WOODS} = **70**

Compute Percent Imperviousness, I (Total Site)

I = Impervious Area / Site Area

Existing Impervious Area= 0 SF I = 0.0% *of site*
Proposed Impervious Area= 2,168 SF I = 50.0% *of site*

Based on % Site Development Category is : **New Development**

Stormwater Management Requirements

Project:	425 Third Street		
Job No.:	18-6671		
County:	Anne Arundel		
By:	KMB	*Date:*	02/26/19
Check:	XXX	*Date:*	XX/XX/XX

Determine Target ESD_V

Percent Imperviousness

I = Impervious Area / Site Area

I =	50.0 %

Where:

Site Area = 4,335 ft^2

Dimensionless Runoff Coefficient

$R_v = 0.05 + 0.009(I)$

R_v =	0.500

Where:

I = 50.0 %

Target Pe

Using Table 5.3 with the Percent Imperviousness and Soil Type above, determine the Target Pe.

HSG	Area (ft^2)	% SITE	Pe (in)
A	0	0.00%	2.0
B	0	0.00%	1.8
C	4,335	100.00%	1.8
D	0	0.00%	1.8

P_e =	1.80	in.(s)

Where:

I = 55.0 %

Target ESDv

$$ESD_V = \frac{(P_e)(R_V)(A)}{12}$$

ESD_v =	325.19	ft^3

Where:

A = 4,335 ft^2

ESDv Runoff Depth

$$Q_e = (P_e)(R_v)$$

ESD Runoff Depth, QE (in):	0.900

Where:

Pe= 1.80 in.

Water Quality Volume

$$WQ_V = \frac{(P_e)(R_V)(A)}{12}$$

WQv=	180.66	ft^3

Where:

Pe= 1.00 in.

Required Recharge Volume

$$\mathrm{Re}_V = \frac{(S)(R_V)(A)}{12}$$

Rev= 0.0005 ac-ft or 23.49 cf

S = HSG % of site = 0.13

*S Factors from MDE 2001 Manual

HSG	Recharge Factor
A	0.38
B	0.26
C	0.13
D	0.06

Environmental Site Design

M-6 | Micro-Bioretention

Drainage Area: | Device Name: MB-1

Concept Design:

Contributing Drainage Area=	2450	ft^2	0.06 acres
Impervious Coverage =	522	ft^2	0.01 acres
Percent Impervious (I)=	21.30612	%	
$R_v = 0.05 + 0.009(I)$ =	0.241755		

ESD_V Required

$ESD_{V,Req.} = (P_E \times R_V \times A) / 12$ =	89	CF
Pe Reqired =	1.80	in.
75% of ESDV,Req. =	66.63375	CF

ESD_V Provided

Media Depth, df =	3.50	FT.
Mulch =	2	in.
Planting Soil =	24	in.
Pea Gravel=	4	in.
Gravel =	12	in.
Surface Area, Af =	70	SF
Surface Area Required =	49	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
11.50	0.00	70.00	0.00	0.00	0.00	0.00
11.75	0.25	96.00	83.00	20.75	20.75	20.75
12.00	0.25	126.00	111.00	27.75	27.75	48.50
				Total Storage Volume Provided =		**48.50** CF

Depth of Enhanced Filter = in.

Total Combine Storage:

Ponding Storage =	48.50	cf
Media Storage =	98.00	cf
Enhanced Filter =	0.00	cf
ESDv provided =	146.50	cf

(n x Af x Media depth (df)) = Media Storage

Pe Prov. = 2.97 in.

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_v)}{12}$$

Max. ESDv= 133.27 ft^3

Environmental Site Design

M-6 Micro-Bioretention

Drainage Area: Device Name: RRG-1

Concept Design:

Contributing Drainage Area=	578	ft^2	0.01	acres
Impervious Coverage =	578	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Required

$ESD_{V,Req.} = (P_E \times R_V \times A) / 12$ =	82	CF
Pe Reqired =	1.80	in.
75% of ESDV,Req. =	61.77375	CF

ESD_V Provided

Media Depth, df =	3.58	FT.
Mulch =	3	in.
Planting Soil =	24	in.
Pea Gravel=	4	in.
Gravel =	12	in.
Surface Area, Af =	53	SF
Surface Area Required =	12	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
11.50	0.00	53.00	0.00	0.00	0.00	0.00
11.75	0.25	53.00	53.00	13.25	13.25	13.25
12.00	0.25	53.00	53.00	13.25	13.25	26.50

Total Storage Volume Provided = **26.50** CF

Depth of Enhanced Filter = in.

Total Combine Storage:

Ponding Storage =	26.50	cf	
Media Storage =	75.97	cf	(n x Af x Media depth (df)) = Media Storage
Enhanced Filter =	0.00	cf	
ESDv provided =	102.47	cf	Pe Prov. = 2.24 in.

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_v)}{12}$$

Max. ESDv= 123.55 ft^3

Environmental Site Design

M-6 | Micro-Bioretention

Drainage Area: | Device Name: RRG-2

Concept Design:

Contributing Drainage Area=	247	ft^2	0.01	acres
Impervious Coverage =	247	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Required

$ESD_{V,Req.} = (P_E \times R_V \times A) / 12$ =	35	CF
Pe Reqired =	1.80	in.
75% of ESDV,Req. =	26.39813	CF

ESD_V Provided

Media Depth, df =	3.58	FT.
Mulch =	3	in.
Planting Soil =	24	in.
Pea Gravel=	4	in.
Gravel =	12	in.
Surface Area, Af =	24	SF
Surface Area Required =	5	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
11.50	0.00	24.00	0.00	0.00	0.00	0.00
11.75	0.25	24.00	24.00	6.00	6.00	6.00
12.00	0.25	24.00	24.00	6.00	6.00	12.00

Total Storage Volume Provided = **12.00** CF

Depth of Enhanced Filter = in.

Total Combine Storage:

Ponding Storage =	12.00	cf	
Media Storage =	34.40	cf	(n x Af x Media depth (df)) = Media Storage
Enhanced Filter =	0.00	cf	
ESDv provided =	46.40	cf	Pe Prov. = 2.37 in.

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_v)}{12}$$

Max. ESDv=	52.80	ft^3

Environmental Site Design

M-6 Micro-Bioretention

Drainage Area: Device Name: RRG-3

Concept Design:

Contributing Drainage Area=	804	ft^2	0.02	acres
Impervious Coverage =	804	ft^2	0.02	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Required

$ESD_{V,Req.} = (P_E \times R_V \times A) / 12$ =	115	CF
Pe Reqired =	1.80	in.
75% of ESDV,Req. =	85.9275	CF

ESD_V Provided

Media Depth, df =	3.58	FT.
Mulch =	3	in.
Planting Soil =	24	in.
Pea Gravel=	4	in.
Gravel =	12	in.
Surface Area, Af =	63	SF
Surface Area Required =	17	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	1.00	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
11.50	0.00	63.00	0.00	0.00	0.00	0.00
11.75	0.25	63.00	63.00	15.75	15.75	15.75
12.00	0.25	63.00	63.00	15.75	15.75	31.50

Total Storage Volume Provided = **31.50** CF

Depth of Enhanced Filter = in.

Total Combine Storage:

Ponding Storage =	31.50	cf
Media Storage =	90.30	cf
Enhanced Filter =	0.00	cf
ESDv provided =	121.80	cf

(n x Af x Media depth (df)) = Media Storage

Pe Prov. = 1.91 in.

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_{1'})}{12}$$

Max. ESDv= 171.86 ft^3

Environmental Site Design

N-2	Disconnection of Non-Rooftop Runoff		
Drainage Area:		Device Name:	Drive Strips

Concept Design:

Contributing Drainage Area=	243	ft^2	0.006	ac.
Maximum Drainage Area =	1000	ft^2		
Impervious Coverage =	243	ft^2	0.006	ac.
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESDv Provided:

Pervious Length=	63	ft.	Max. Contributing Pervious length = 150-ft
Contributing Imp. Length =	63	ft.	Max. Contributing Imp. Length = 75-ft.
Impervious Ratio=	1:1		
Pervious Ratio =	0.5:1		(Per Table 5.7 (page 5.62)
Pe Provided =	1.0	in.	MD State SWM Manual

$$ESD_v = \frac{(P_E)(A)(R_V)}{12}$$

ESDv=	19.24	ft^3

Table 5.7 ESD Sizing Factors for Non-Rooftop Disconnection

Ratio of Disconnection Length to Contributing Length					
Impervious Ratio	0.2:1	0.4:1	0.6:1	0.8:1	1:01
Pervious Ratio	0.1:1	0.2:1	0.3:1	0.4:1	0.5:1
Pe (in.)=	0.2	0.4	0.6	0.8	1.0

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	51.94	ft^3